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Results of seed investigations for 1908 and 1909

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EXPERIMENT STATION

IOWA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS

RESULTS OF SEED INVESTIGATIONS FOR 1908 and 1909

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SUMMARY OF BULLETIN 115

1. The quality of seed sold to the Iowa farmers is much better than it was before the passage of the Iowa seed law. The cost of cleaning seed, however, makes it necessary for the seed companies to charge higher prices for the best quality.

2. Field tests of seeds always show a lower germination than tests made indoors.

3. Seeds of such weeds as Canada thistle, dodder, night flowering catchfly, and buckhorn are not found in clover and grass seeds as frequently as formerly. Seeds of sour dock, sheep sorrel, pigeon grass, Rugel's plantain, and crab grass are frequently found.

4. The percentage of impurities in any sample of grass seed can be really determined by a method devised by this Station and described on page 162.

5. It is very difficult to distinguish between the "seed" of quack grass and that of western wheat grass. Quack grass seed is usually smoother.

6. Weed seeds germinate more readily after being frozen.

RESULTS OF SEED INVESTIGATIONS FOR 1908 AND 1909

L. H. PAMMEL. CHARLOTTE M. KING.

INTRODUCTION

Since the publication of bulletins 88 and 99 on the subject of seed investigation, the Botanical Section has continued a study of the seeds offered for sale to the farmers of Iowa. Bulletin 88 contains the studies for 1906, bulletin 99 the studies for 1907, and the present publication contains the results of our work for 1908 and 1909.

Since the operation of the Iowa law it has been our experience that the quality of the seed sold to the farmers is much better than formerly. Hundreds of samples sent to us by the farmers of this state for analysis indicate that they desire to protect themselves from the introduction of noxious weeds, especially dodder, quack grass, buckhorn, dock, and Canada thistle. The farmers have also learned that it is far better to buy a better quality of seed, seed that does not contain these noxious weeds, than that containing a goodly number of weed seeds that would prove harmful to agriculture.

Nearly every seed merchant is prepared to sell a good quality of seed, but owing to the difficulties of cleaning and removing some of the weed seeds, a large amount of clover seed is wasted or cannot be used to make the best quality of seed. It it only reasonable, therefore, that they should receive a higher price for the best quality seed. Our experience has shown that the farmer is not interested so much in vitality as he is in the freedom from noxious weeds. This has been the experience of Seed Commissioner Clark of Canada, and others who have investigated this problem. The vast majority of requests that come to us ask for a purity test only.

From a study of the analyses that were reported by different investigators, we find that only a small percentage of the samples contained dodder. This was reported from Connecticut, Nebraska, Virginia, Maine, and Oklahoma. Buckhorn is reported 64 times in red clover from Maine. Twenty-four per cent of the samples of alfalfa in Oklahoma contain it but it is found in only 3 out of 22 samples of timothy sold in Virginia. Bracted plantain seems to be on the increase in clover seed in some sections of the country, especially the clover seed coming from sections south of the Iowa line. Quack grass is occasionally reported,

and Dr. E. Mead Wilcox and Miss Stevenson of Nebraska, report that agropyron was a frequent impurity in brome grass, but they do not state whether it was the western wheat grass, the quack grass, or the slender wheat grass. Since much of the seed of brome grass is grown in sections where western wheat grass is common, it is likely that the agropyron reported belonged to this species rather than to quack grass.

TESTS OF CLOVER GRASS SEED FOR 1908 AND 1909

The seeds tested in 1908 and 1909 were for the most part dealers' seeds sent to farmers. Sometimes they were seeds of the farmer's raising that had been cleaned.

The purity of clover was higher in 1909 than in 1908.

The average vitality tests do not differ greatly for the two years.

The results of the three different tests vary with the degree of constancy of conditions. The field test is always lower than the others.

At the time of field test for May 1, 1909, the weather was rainy and cold, thus accounting for low percentage of germination at that time.

TABLE I. SUMMARY OF RESULTS OF SEED TESTS, 1908.*

Kind	No. of Sam'les	Percentage of Purity			Per'tge of Germ'n't'n		
		Lowest	Highest	Av'rage	Blott'rs 3-17	Sand Indoors	Field 3-28
Mammoth Clover	3	96.5	99.9	98.7	92.	82.	35.2
Red Clover	71	74.	99.9	95.2	89.4	72.37	55.6
Medium Clover	9	95.3	99.9	98.8	87.6	54.7	61.
Alsike Clover	20	88.	99.3	96.8	79.1	51.1	53.3
Alfalfa	13	95.6	100.	98.9	77.4	55.8	60.3
Timothy	21	97.	100.	89.9	97.9	78.8	52.4

*For the ten days period of this test, the daily maximum temperature varied from 35° to 67°F., the daily minimum from 16° to 41°; average maximum was 53°; average minimum was 31.1°; precipitation was .15 inches.

The first field test was made in rainy weather; the second and third field tests were made about three weeks later, with more settled and warmer weather. The blotter test gave highest averages, in correspondence to its more uniform conditions. These studies indicate that environment plays an important part in the germination of seeds. Red clover samples No. 104 for 1909 and No. 71 for 1908 illustrate this variation.

TABLE 2. SUMMARY OF RESULTS OF SEED TESTS, 1909.*

Kind	No. of	P'c't'ge of Purity			Percentage of Germination				
		L'w'st	Hig'st	Av'ge	Blott'rs 4-24	Sand 5-6 ind'rs	Field 5-1	Field 6-1	Field 7-5
Red Clover.....	104	75.	100.	97.7	82.9†	75.6	55.9	73.	67.
Mammoth Clover....	6	97.8	100.	99.5	------	-----	-----	84.6	70.5
Medium Clover.....	19	98.2	100.	99.5	------	-----	-----	-----	-----
Alsike Clover.....	13	94.4	99.8	99.	83.7	83.7	34.7	77.4	64.
Alfalfa	8	98.9	100.	99.7	89.1	52.7	61.1	78.1	62.
Timothy	34	91.2	100.	98.7	99.3	85.1	21.4	87.	-----
White Clover.....	2	99.1	99.9	99.5	63.	77.	24.	89.	42.

†Red Clover, thirty-eight samples tested for germination.

*For the ten days period of the first field test, the daily maximum temperature varied from 58° to 89° F.; the minimum varied from 25° to 50°; the average maximum was 69.2°; the average minimum 34.8°; precipitation was a trace.

For the ten days period of the second field test, the daily maximum temperature varied from 64° to 89°; the minimum from 53° to 66°; the average maximum was 77.8°; the average minimum was 55.7°; precipitation 1.04 inches.

For the ten days period of the third field germination, the daily maximum temperature varied from 64° to 88°; the minimum varied from 55° to 68°; the average maximum was 79.8°; the average minimum was 62.8°; the precipitation was 2.45 inches. These records are from official reports.

TABLE 3. RESULTS OF GERMINATION TESTS OF SEED GROWN IN 1906 AND TESTED IN 1907 AND 1909.

Kind	Percentage of Germination	
	Indoors in Sand April 1907	In field 7-5 1909
Red Clover— Average 4 samples.....	87.5	20.2
Timothy— Average 3 samples.....	94.	----------
Mammoth Clover— Average 3 samples.....	84.3	14.3
Alsike Clover— Average 3 samples.....	82.6	33.3
Alfalfa— Average 3 samples.....	80.	33.3
White Clover— Average 3 samples.....	76.6	5.3

TABLE 4. RESULTS OF GERMINATION TESTS OF SEED GROWN IN 1907 and TESTED IN 1908 AND 1909.

Kind	Percentage of Germination	
	In field 5-1 1908	In field 7-5 1909
Red Clover—		
Average 3 samples	56.	5.7
Bluegrass—		
Average 2 samples	23.	12.
Timothy—		
Average 2 samples	49.	17.
Mammoth Clover—		
Average 1 sample	85.	67.
Alsike Clover—		
Average 3 samples	56.5	59.
Alfalfa—		
Average 3 samples	55.	59.

THE IMPURITIES OF AGRICULTURAL SEEDS

The nature of the improvement in purity may be seen from the tables which follow.

In 1908 and 1909 Canada thistle was not so frequent as previously; the same is true of dodder, nightflowering catchfly, and buckhorn; although the buckhorn is all too frequent in some types of clover seed. Sour dock and sheep sorrel were frequent in many samples. In western grown clover, pigeon grass, Rugel's plantain, and crab grass are frequent impurities.

WEIGHT OF WEED SEEDS

The weight of weed seeds and number of seeds to certain given measures, are given in the following table. (Table 6.)

Columns one and two furnish data for determination of impurity percentage by weight; columns three and four enable the determination of percentage by an approximation method, used by J. R. Campbell and explained later.

In estimating the weights listed there were used, so far as possible, seeds of average size and fresh condition.

TABLE 5. WEED SEED IMPURITIES PRESENT IN SEED OF CLOVERS, ALFALFA, TIMOTHY, ETC., EXAMINED IN 1908 AND 1909*

Impurities.	Red Clover		Medium Clov'r		Mam'oth Cl'v'r		Alsike Clover		White Clover	White Clover		Timothy		Timothy and Alsike Mixture	Millet	Oats
	1908	1909	1908	1909	1908	1909	1908	1909	1909	1908	1909	1908	1909	1909	1909	1909
Acalypha virginica (Mercury, Three-seeded)	----	11.	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Agropyron repens (Quack-grass)	----	1.	----	----	----	----	----	----	----	----	----	----	6.	12.5	----	----
Agrostis alba	1.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Amaranthus graecicans (Pigweed)	1.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Amaranthus retroflexus (Rough Pigweed)	16.5	4.	----	----	----	----	----	----	----	----	----	5.	----	----	----	----
Ambrosia artemisiaefolia (Small Ragweed)	22.	16.	22.	5.2	22.	16.6	----	----	----	----	----	----	----	12.5	100.	----
Anthemis Cotula (Mayweed)	1.4	----	----	----	----	----	5.	7.5	----	----	----	5.	----	----	----	----
Brassica arvensis (Common Mustard)	1.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Brassica nigra (Mustard)	4.5	2.	----	5.2	----	----	----	----	----	----	----	5.	----	----	----	75.
Bromus (Brome grass)	1.4	----	11.	----	----	----	----	----	----	7.7	----	----	----	----	----	----
Brunella vulgaris (Self-heal)	3.	----	11.	5.2	----	----	----	----	----	7.7	----	5.	----	12.5	----	----
Capsella bursa-pastoris (Shepherd's Purse)	----	----	----	----	----	----	33.	----	----	----	----	5.	----	----	----	----
Carex (Sedge)	----	----	----	----	----	----	5.	----	----	----	----	----	9.	----	----	----
Chenopodium album (Lamb's quarter)	30.	17.	----	11.	----	----	----	----	15.	7.7	12.5	25.	----	----	----	----
Chenopodium Boscianum	1.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cichorium Intybus (Chicory)	4.5	----	22.	----	----	----	----	----	----	7.7	12.5	----	----	----	----	----
Cirsium arvense (Canada Thistle)	----	1.	----	----	----	----	----	----	----	7.7	----	----	----	----	----	----
Cirsium lanceolatum (Bull Thistle)	3.	1.	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Convolvulus sepium (Morning Glory)	3.	----	----	----	----	----	----	----	----	----	----	----	----	----	----	50.
Convolvulus arvensis	1.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cuscuta arvensis (Dodder)	10.	2.	----	----	----	----	----	----	----	7.7	----	----	----	----	----	----
Dalea lanata (Dalea)	----	----	----	----	----	----	----	----	----	7.7	----	----	----	----	----	----

*The figures given are the percentages of the samples examined in which the various impurities were found.

TABLE 5 (Con).

	Red Clover		Medium Clov'r	Mam'otd Clv'r	Alsike Clover		White Clover	White Clover	Timothy		Timothy and Alsike Mixture	Millet	Oats
Daucus carota (Wild Carrot)	6.	2.	11.					24.5	12.5				
Digitaria humifusa (Crabgrass, Smooth)	30.	9.		5.2				17.5					
Digitaria sanguinale (Crabgrass)	20.	32.	22.		33.			17.5			12.5		
Echinochloa crusgalli (Barnyard Grass)	13.5	11.								3.		100.	
Eupatorium ageratoides (Snakeroot, White)	10.								5.		12.5		
Euphorbia Preslii (Spurge)	3.	4.	11.	5.2	33.	7.5				3.			
Eupatorium urticaefolium (White Snakeroot)										3.			
Galium arvensis (Bedstraw)								7.7					
Glycyrrhiza lepidota (Licorice)													25.
Grindelia squarrosa (Gumweed)									25.				
Helianthus grosseserratus (Wild Sunflower)													25.
Heliopsis scabra (Oxeye)			11.										
Lactuca scariola (Prickly Lettuce)									5.				
Lepidium apetalum (Peppergrass)	4.5	2.			35.		30.		45.	12.	12.5		
Linum usitatissimum (Flax)													25.
Medicago lupulina (Yellow Trefoil)	1.4												
Medicago sativa (Alfalfa)									5.				25.
Melilotus alba (Sweet Clover)								17.5					
Monarda fistulosa (Horsemint)								17.5					
Muhlenbergia diffusa (Diffuse Dropseed)	1.4												
Muhlenbergia glomerata (Dropseed)	1.4	1.									12.5		
Muhlenbergia Mexicana (Mexican Dropseed)	9.	8.											
Oenothera biennis (Evening Primrose)		1.								9.	12.5		
Panicum capillare (Old-Witch Grass)	22.	9.	11.		5.		50.	7.7					
Panicum miliaceum (Millet)	3.	5.	11.	33.									

TABLE 5 (Con.)

	Red Clover		Medium Clover		Mam'th Clover		Alsike Clover		White Clover	White Clover		Timothy		Timothy and Alsike Mixture	Millet	Oats	
Panicum proliferum (Spreading Crabgrass)	1.4	3.	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Phleum pratense (Timothy)	74.	----	33.	15.	66.	33.3	100.	15.	----	53.5	12.5	----	----	----	----	----	----
Physalis pubescens (Ground Cherry)	----	----	11.	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Picris echioides (Ox-tongue)	----	----	----	----	----	----	----	----	----	17.5	----	----	----	----	----	----	----
Plantago aristata (Bracted Plantain)	7.5	2.	11.	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Plantago lanceolata (Ribgrass)	30.	21.	33.	19.	----	----	----	7.5	----	45.	75.	----	----	----	----	----	----
Plantago major (Dooryard Plantain)	1.4	1.	----	5.2	----	----	----	----	----	----	3.	----	----	----	----	----	----
Plantago Rugelii (Rugel's Plantain)	----	58.	11.	19.	----	33.3	5.	15.	100.	----	----	29.	62.	37.5	----	----	----
Polygonum aviculare (Dooryard Knotgrass)	1.4	----	----	----	----	----	----	----	----	----	----	5.	----	----	----	----	----
Polygonum convolvulus (Bindweed)	1.4	1.	----	----	----	----	----	----	----	----	----	10.	6.	----	100.	----	----
Polygonum Persicaria (Lady's Thumb)	18.	27.	----	19.	----	16.6	5.	----	----	----	----	----	----	----	----	----	----
Polygonum ramosissimum (Knotweed)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Polygonum scandens (Climbing False Buckwheat)	----	----	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	----
Potentilla monspeliensis (Five-finger)	3.	2.	----	----	----	16.6	20.	----	50.	----	----	10.	23.	37.5	----	----	----
Rosa pratincola (Rosa)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25.
Rumex acetosella (Sorrel)	18.	6.	22.	15.	33.	----	25.	53.	----	----	----	10.	----	12.5	----	----	----
Rumex crispus (Curled Dock)	28.	18.	11.	19.	----	52.	10.	30.	----	7.7	12.5	----	6.	----	----	----	----
Salsola Kali var tenuifolia (Russian Thistle)	----	----	----	----	----	----	----	----	----	----	12.5	----	----	----	----	----	----
Setaria glauca (Pigeon-grass)	52.	65.	22.	42.	33.	33.3	----	23.	----	17.5	25.	----	3.	12.5	50.	25.	----
Setaria italica (Millet)	3.	1.	----	----	33.	----	----	7.5	----	----	----	----	----	----	----	----	----
Setaria viridis (Green Foxtail)	49.	10.	44.	15.	33.	----	----	----	----	38.5	12.5	10.	----	12.5	----	----	----
Silene noctiflora (Night-flowering Catchfly)	7.5	5.	11.	15.	----	----	25.	60.	----	----	----	----	----	----	----	----	25.
Stellaria media (Chickweed)	----	2.	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	----
Teucrium canadense (Germander)	----	----	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	----

TABLE 5 (Con.)

	Red Clover		Medium Clov'r		Mam'th Clv'r		Alsike Clover		White Clover		White Clover		Timothy		Timothy and Alsike Mixture	Millet	Oats
Thlaspi arvense (Penny Cress)	----	----	11.	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Trifolium hybridum (Clover, Alsike)	18.	2.	----	5.2	----	16.6	----	----	----	30.	----	25.	18.	12.5	50.	----	
Trifolium pratense (Red Clover)	----	----	11.	----	----	----	50.	----	----	24.5	----	49.	26.	12.5	----	----	
Trifolium repens (White Clover)	7.5	2.	11.	5.2	----	16.6	33.	----	----	----	----	10.	3.	12.5	----	----	
Triticum sativum (Wheat)	----	----	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	
Verbena hastata (Vervain)	----	3.	----	----	----	16.6	----	----	----	----	----	----	----	12.5	----	----	
Verbena stricta (Vervain)	1.4	----	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	
Vicia sativa (Vetch)	----	----	----	----	----	----	----	----	----	----	----	----	3.	----	----	----	75.
Smutted grass seed	----	3.	----	11.	----	----	----	----	----	----	----	----	----	----	----	----	
Ergot	----	----	----	----	----	----	----	----	----	----	----	----	6.	----	----	----	

TABLE 6. TABLE OF WEED SEED WEIGHTS.

	No. of Seeds per gram	weight of 1 Seed in Milligrams	No. of Seeds in one per cent of 5 g. (1 teaspoonful)	No. of Seeds in one per cent of 4 g. (1 teaspoonful)
Abutilon Theophrasti (Velvet Leaf)	109	9.15	5	4
Acnida tuberculata (Water Hemp)	2800	.36	150	113
Agropyron repens (Quack Grass)	360	2.77	20	16
Amaranthus retroflexus (Tumble-weed)	2684	.37	135	110
Ambrosia artemisiaefolia (Small Rag-weed)	360	2.77	20	16
Anthemis Cotula (Mayweed)	4200	.24	210	168
Arctium Lappa (Burdock)	320	3.12	16	13
Avena fatua (Wild Oats)	45	22.22	2	1.6
Avena sativa (Oats)	38	26.1	2	1.5
Brassica arvensis (Wild Mustard)	496	2.02	24	19
Brassica nigra (Black Mustard)	1280	.79	62	48
Bromus arvensis (Field Brome)	533	1.89	26	21
Camelina sativa (False Flax)	900	1.11	45	36
Carex medium size (Sedge)	2858	.35	14	12
Cassia Chamaecrista (Partridge Pea)	119	8.4	6	5
Chenopodium album (Lamb's-quarter)	1440	.69	72	57
Cichorium Intybus (Chicory)	800	1.25	40	32
Cirsium arvense (Canada Thistle)	880	1.13	45	36
Cirsium discolor (Common Thistle)	174	6.79	20	16
Cirsium lanceolatum (Bull Thistle)	456	2.19	23	19
Chilean Dodder	1250	.8	63	50
Cuscuta arvensis (Field Dodder)	1688	.59	84	67
Cuscuta Epithymum (Clover Dodder)	3840	.26	200	160
Dalea alopecuroides (Dalea)	350	2.86	14	11
Dactylis glomerata (Orchard Grass)	1370	.73	62	48
Datura Stramonium (Jimson Weed)	146	6.25	20	16
Daucus Carota (Wild Carrot)	1250	.8	63	50
Digitaria humifusa (Smooth Crab-grass)	3700	.26	192	155
Digitalis sanguinalis (Crabgrass)	3640	.27	185	142
Echinochloa crusgalli (Barnyard Grass)	1400	.72	62	48
Elymus virginicus (Wild Rye)	190	5.27	94	75
Euphorbia Preslii (Spurge)	1720	.58	84	67
Hibiscus Trionum (Bladder Ketmia)	304	3.28	16	13
Ipomoea purpurea (Morning-glory)	41	24.4	2	1.6
Lepidium apetalum (Peppergrass)	2515	.39	125	100
Liatris punctata (Blazing Star)	300	3.30	16	12
Medicago hispida (Bur Clover)	370	2.6	20	16
Medicago lupulina (Yellow Trefoil)	692	1.45	33	26
Medicago sativa (Alfalfa)	452	2.21	20	16
Monarda fistulosa (Horsemint)	1080	.93	55	44
Muhlenbergia glomerata (Dropseed)	9400	.11	500	400

TABLE 6 (Con.) TABLE OF WEED SEED WEIGHTS

	No. of Seeds per gram	Weight of 1 Seed in Milligrams	No. of Seeds in one per cent of 5 g. (1 teaspoonful)	No. of Seeds in one per cent of 4 g. (1 teaspoonful)
Muhlenbergia mexicana (Mexican Dropseed)	3130	.32	150	120
Nepeta Cataria (Catnip)	1076	.93	55	44
Oxybaphus nyctagineus (Wild Four-o'clock)	404	2.48	20	16
Panicum capillare (Tickle-grass)	2592	.38	125	100
Paspalum laeve (Paspalum)	990	1.01	50	40
Phleum pratense (Timothy)	2888	.35	143	114
Physalis pubescens (Groundlcherry)	750	1.37	36	28
Plantago aristata (Bracted Plantain)	760	1.36	36	28
Plantago lanceolata (Buckhorn)	1152	.87	56	46
Plantago Rugelii (Rugel's Plantain)	1704	.45	111	89
Poa pratensis (Kentucky Blue-grass)	17050	.059	833	664
Poa serotina (False Red-top)	10370	.095	526	420
Polygonum Convolvulus (Black Bindweed)	216	4.65	11	9
Polygonum Hydropiper (Water Smartweed)	990	1.1	45	36
Polygonum hydropiperoides (Mild Water Smartweed)	358	2.8	18	11
Polygonum lapathifolium (Pale Persicaria)	640	1.57	31	25
Polygonum pennsylvanicum (Pennsylvania Smartweed)	200	5.	10	8
Polygonum Persicaria (Lady's Thumb)	712	1.4	36	28
Potentilla monspeliensis (Five-finger)	11880	.084	593	480
Rumex acetosella (Sheep Sorrel)	200	5.	10	8
Rumex crispus (Curled Dock)	728	1.37	36	29
Rumex obtusifolia (Blunt-leaved Dock)	846	1.18	42	36
Saponaria Vaccaria (Cowherb)	228	4.38	12	10
Salsola Kali var tenuifolia (Russian Thistle)	1300	.769	65	53
Scrophularia marilandica (Simpson Honey Plant)	6690	.14	358	287
Setaria glauca (Yellow Foxtail)	815	1.28	39	32
Sataria italica (Millet)	544	1.83	27	22
Setaria viridis (Green Foxtail)	2140	.469	63	52
Sida spinosa (Spiny Sida)	980	1.135	44	39
Silene noctiflora (Night-flowering Catchfly)	1000	1.	50	40
Silene stellata (Catchfly)	900	1.11	45	36
Thalictrum purpurascens (Meadow-rue)	496	2.02	25	20
Trifolium hybridum (Alsike)	1604	.623	73	59
Trifolium pratense (Red Clover)	662	1.49	33	26
Trifolium repens (White Clover)	1904	.529	94	75

TABLE 6 (Con.) TABLE OF WEED SEED WEIGHTS.

	No. of Seeds per gram	weight of 1 Seed in Milligrams	No. of Seeds in one per cent of 5 g. (1 teaspoonful)	No. of Seeds in one per cent of 4 g. (1 teaspoonful)
Triticum sativum (Winter Wheat).	34	29.4	2	1.5
Triticum sativum (Spring Wheat)..	34	29.4	2	1.5
Verbena stricta (Wild Verbena).....	1028	.972	50	40
Verbena urticaefolia (Vervain).....	2408	.413	24	20

To find number of foreign seeds to the ounce of seed examined, multiply the number found in one gram by 28.35. To find the number of foreign seeds to the pound, multiply the number found in one gram by 453.58.

To detemine percentage of foreign seed by weight, weigh out one gram of the seed to be examined, separate out all foreign seeds, and count the number of each kind.

Proceed with each kind of foreign seed as follows: Multiply the number of seeds found by the weight of one seed in milligrams as given in the table. Find proportion of this weight to 1 gram (or 1,000 milligrams). This is the percentage of this particular seed. Chaff and waste matter must be separately picked out and weighed.

When percentages of all weed seeds have been so determined, find the sum. This result is the aggregate percentage of foreign seed. Subtract the result from 100 to obtain percentage of purity.

HOME ANALYSIS OF SEEDS

The following simple method of analyzing seed of red clover, alfalfa and alsike was devised by Mr. J. R. Campbell.

Take small quantities of seed from eight or ten portions of the seed to be examined, and mix these thoroughly in a cup or sack. From this take again small portions, enough to make altogether a very slightly rounded teaspoonful of seed. This quantity will approximate in weight to 5 grams. Pour this quantity on a smooth white surface, and with a tooth-pick or other slender instrument, and with the aid of a hand magnifying lens sort out into two piles, one containing all the clean seed the other all the weed seeds and dirt. Now separate out and count the weed seeds of each different kind.

With the aid of the foregoing table the percentages for each kind of foreign seed may be computed. For example, 86 seeds of barnyard grass equal 1 per cent of the sample; if the sample

contains 34 seeds of barnyard grass, the percentage is ½ per cent; if 136 seeds are found, the sample contains 2 per cent of the grass, and so proportionately for other numbers of the same seed.

The amount of dirt can only be estimated by comparison of quantity with a given measure of the clover seed.

For timothy, blue-grass, and millet seed use the same measure, that is, the slightly rounded teaspoonful. This given quantity approximates in weight to 4 grams. Therefore a different set of figures must be used to represent the number of weed seeds which make 1 per cent. These are found in the last column.

Separate out all impurities as before, and count the foreign seed of each different kind. From these numbers one can readily compute the percentages present, by keeping in mind the number required to make 1 per cent of the sample.

Although any two tests of the same seed will be likely to differ somewhat, the home-testing method, if carefully worked out, will give results close enough for the purposes of the Iowa seed law.

COMPARATIVE RESULTS OF THE TWO METHODS

Test 1, is of 2 grams of a given sample of clover, percentages determined by use of seed weights in column two of table. Test 2 is of another 2 gram portion of same sample, used as check. Test 3 is of a 4 gram or teaspoonful sample, percentages determined by column three.

TABLE 7. COMPARATIVE TESTS OF WEED SEEDS.

SAMPLE A.

	Test 1		Test 2		Test 3	
	No. of Seeds	per cent	No. of Seeds	per cent	No. of Seeds	per cent
Rugel's Plantain	77	1.73	81	1.84	200	1.8
Timothy	65	1.1	42	.73	127	.9
Smutted Foxtail	2	.06	------	------	7	.08
Lady's Thumb	1	.04	1	.04	4	.08
Pigeon Grass	5	.32	4	.25	11	.24
Curled Dock	2	.14	2	.14	8	.26
Crabgrass	2	.06	1	.02	4	.02
Dirt (estimated)	------	2.	------	2.	------	2.
Total	------	5.45	------	5.02	------	5.38
Purity	------	94.55	------	94.98	------	94.62

TABLE 7 (Con.) COMPARATIVE TESTS OF WEED SEEDS.

SAMPLE B.

	2 gram Test per cent	4 gram (teaspoonful Test per cent
Lady's Thumb	.05	.19
Verbena	.04	.08
Ragweed	.1	.1
Timothy	1.2	1.25
Ribgrass	1.6	1.7
Crabgrass	.6	.8
Rugel's Plantain	.2	.12
Hair Grass	.05	.05
Three-seeded Mercury	.08	.08
Bracted Plantain	.05	.09
Total	3.97	4.46
Purity	96.03	95.54

SAMPLE C.

	2 gram Test Per cent	4 gram teaspoonful Test per cent
Crabgrass	.02	.05
Pigeon grass	.12	.12
Lamb's quarter	.04	.05
Smartweed	.02	.025
Lady's Thumb	.06	.03
Total	.26	.275
Purity	99.74	99.725

QUACK GRASS "SEED" AND WESTERN WHEAT GRASS "SEED" COMPARED

In 1908, 1909, and the beginning of 1910, we had several requests from Mr. Chas. N. Page of Des Moines, to determine whether brome grass had as impurities quack grass or western wheat grass. Dr. Wilcox of the Nebraska Experiment Station has reported the presence of agropyron in brome grass, leaving the matter as to whether it was quack grass or western wheat grass undetermined.

In the samples of Hungarian brome grass sent to us by Mr. Page we concluded that the seed contained western wheat grass rather than the quack grass. But this opened up the question as to whether it was possible always to distinguish between the "seeds" of the two types of plants. The "seed' of quack grass with attached scales (palea and flowering glume) does not ap-

pear from casual observations to differ essentially from the western wheat grass, but a more careful investigation indicated to us that the scales of quack grass are smoother, being slightly downy, while frequently the scales of western wheat grass are more hairy. But even here we find that there is a good deal of difference. For instance, a sample of seed sent out by the United States Department of Agriculture and labeled quack grass, is much more hairy than the samples as we ordinarily find it in the Mississippi Valley, and especially in Iowa. It is very important for the seedsman to know whether it is quack grass or western wheat grass because under the Iowa law the presence of quack grass "seed" makes the sale of the seed illegal, while western wheat grass is not so discriminated against. No doubt in some cases the origin of the seed will determine whether it is western wheat grass or quack grass, as much of our Hungarian brome grass seed comes from Nebraska and other western states.

With the idea of determining from a large range of specimens the difference between the two types of seeds, we had Mr. J. R. Campbell study the specimens in the herbarium of the Iowa State College. It was found that in some cases some of the specimens approached each other, especially in regard to the scabrous character of the glumes.

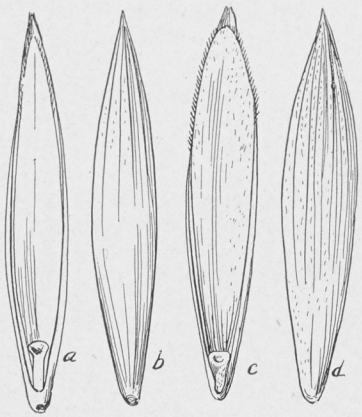

Fig 1. a, b, Quack Grass "seed." c, d, western wheat grass "seed."

Mr. Campbell from his study of a large range of specimens concludes as follows:

"Several fairly constant differences were noted. One of these is the pubescence on the palea, and flowering glume. Another is the shape of the palea, and the occurrence of a fringe of hairs along the margin of

the palea. The typical wesetern wheat grass seed is quite evidently pubescent, or at least puberulent, both on the flowering glume and on the face of the palea. The palea is broad and full, extending completely to the tip of the flowering glume, and is copiously fringed with fine hairs, at least one-third of the distance back from the tip. The quack grass is not generally pubescent, the palea does not extend to the tip of the flowering glume, but leaves a small portion exposed, and the fringe of hair is not so abundant. The general shape of the two "seeds" also differs somewhat. This may be a valuable character in combination with the ones already mentioned. The quack grass "seed" is generally more slender, and spindle shaped, while that of the western wheat grass broadens out somewhat toward the tip, after the manner of the brome, and some other grasses. Authentic samples of each kind of grass, for comparison, are very helpful in the identification of doubtful specimens."

NOTES ON THE DELAYED VITALITY OF WEED SEEDS.

In connection with germination of seeds at different times and under varying conditions, a brief account is here given of results of weed seed tests, of which a full report will be ready for presentation later.

In 1901* observations were begun upon germination of weed seeds under different conditions. Weed seeds planted in the fall of the year did not germinate freely, and germination was much delayed. In 1902 the experiment was continued comparing with results of fall planting, the germination in the spring of sets of the same kinds of seeds, wintered with freezing and without freezing.

It was found that the seeds of different species showed great differences in germination. In general, the results of 1902 and 1903 indicated that stratification in sand and freezing were favorable to germination. The following examples may be used for illustration.

Mr. H. S. Fawcett† made a study of 52 species of weed seeds. The samples were gathered after maturity in September, October and November of 1904. The seeds were threshed out, and

	Per cent of Germination	
	Before Stratification	After Stratification
Milkweed (*A. syriaca*)	0	12
Western Ragweed	0	18
Lamb's Quarter	0	88
Cocklebur	0	25

*Pammel, L. H. Proc. Soc. Prom. Agri. Sci. 24:89.
†Fawcett, H. S. Proc. Io. Acad. Sci. 15:25.

placed in paper envelopes. Fifty seeds of each kind were placed in November in sand boxes kept during the winter in the greenhouse under uniform conditions. Similar plantings were made each month until May. The sand in all these germination trays was kept moist.

In addition a large number of weed samples was placed out of doors for the purpose of subjecting them to freezing and thawing. The seeds were placed in sacks in a wooden box and covered with a thin layer of sand; the box was then deposited about one foot below the surface, where it remained till spring. The general effect of freezing and thawing was to increase the percentage of germination and lessen the dormant period, especially in case of seeds with hard coats; in all cases the dormant period of hard-coated seed seems to be greater than that of thin-coated seeds. The following examples illustrate these differences:

The dormant period of common pigweed (*Amarantus retroflexus*) was 9 1-3 days when kept in packages in a dry room, and 6 1-3 days after having wintered out of doors; its germination was increased from 40 to 50 per cent. In the common pigeon grass the average dormant period was lessened from 11 to 7 1-4 days; the percentage of germination increased from 34½ to 38 per cent. In wild rye the dormant period was lessened from 9 to 5 days; the germination increased from 22 to 48 per cent.

It was found that the longest dormant period was found in those seeds which have the hardest and thickest seed-coats. Some of the ragweed seeds had a dormant period of 152 days, while some seeds of barnyard grass had a dormant period of 178 days.

The highest average percentage of germination was observed in common mustard, which was 100 per cent, and for the six tests, 90.3 per cent.

It has long been known that many seeds refuse to germinate until they have passed a period of rest. Nobbe and Hanlein* made a study of the seeds of 31 species of weedy plants continuing the experiment for 1,173 days. A number of these weeds showed germination after a lapse of 1,173 days. A number of these weeds showed germination after a lapse of 1,173 days; among them were *Campanula persicifolia,* silvery cinquefoil (*Potentilla argentea*), Mousetail (*Myosyrus minimus*), hoary plantain (*Plantago media*), and field penny-cross (*Thlaspi arvense.*)

The experiment of Dr. Beal† is worthy of note.

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*Ueber die Resistenz von Samen gegen die ausseren Factoren der Keimung. Landw. Versuchs Stat. 20:63-96. 1877.

*Ueber die Keimkraft von Unkrautsamen Landw. Versuchs. Stat. 25:465-470. 1880.

†Proc. Soc. Prom. Agrl. Sci. 26:89. 1905

In 1879 there were selected 50 freshly grown seeds of each of 23 different kinds. These seeds were mixed with sand and placed in bottles which were buried in an inverted position, in a sandy knoll. At the end of 5, 10, 15, 20 and 25 year periods sets of seeds were tested for germinability. The following are among the results obtained.

TABLE 8. DR. BEALS EXPERIMENTS IN LONGEVITY.

Name of Seeds	5 yrs	10 yrs.	15 yrs	20 yrs	25 yrs
Amarantus retroflexus .... Tumbling Pigweed	+	+	+	+	+
Ambrosia artemisiaefolia... Small Ragweed	0	0	0	0	0
Brassica nigra ..... Mustard	0	+	+	+	+
Lepidium virginicum ..... Peppergrass	+	+	+	+	+
Lychnis Githago ..... Corn Cockle	0	0	0	0	0
Oenothera biennis ..... Evening Primrose	+	+	+	+	+
Rumex crispus ..... Curled Dock	+	?	+	+	+
Setaria glauca ..... Foxtail	+	+	+	+	+

Of these 23 different kinds, 8 kinds showed no germination. A. J. Ewart* in a recent work upon longevity finds that a form of *Abutilon avicennae,* velvet weed, germinated 6 per cent after 57 years; *Melilotus alba,* white sweet clover, 52 per cent after 44 years; *Cichorum intybus,* chicory, 50 per cent after 10 years.

In view of the interest and value of such observations as those under consideration, the Botanical Section began in 1906, an experiment with seeds of some common Iowa weeds. These seeds were counted out and kept in paper packets in the laboratory. Plantings were made in November, December, January, February, March and April.

Sets of 50 seeds each of the same 130 species were suitably prepared in linen sacks, and buried out of doors, beneath 6 inches of soil, thus subjecting the seeds to the varying conditions of the

*Proc. Roy. Soc. of Victoria, 21:pt. 1. 1. 1898.

Iowa winter. These seeds were carefully removed in April and planted with the April planting of seeds which had wintered in the laboratory.

The following table brings together some cases, for illustration.

TABLE 9. GERMINATION OF SEEDS

Name of weed	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Apr. Sub'ted to freez'g
Abutilon Theophrasti.... Velvet Weed	9.	37.3	11.3	28.6	27.7	37.3	36.
Amaranthus graecizans.. Rough Pigweed	9.3	2.6	.66	------	10.	7.3	32.
Ambrosia artemisiaefolia Small Ragweed	9.2	8.	8.	7.	7.	26.	21.5
Brassica arvensis ..... Charlock	25.5	39.	34.	33.	19.	52.	44.
Cassia Chamaecrista .... Partridge Pea	16.3	13.6	15.3	3.	2.	8.6	33.
Chenopodium album .... Lamb's Quarter	22.6	20.6	2.6	19.3	15.3	3.	44.6
Cirsium lanceolatum..... Bull Thistle	14.	13.3	9.	1.	20.6	16.	34.6
Echinochloa crusgalli.... Barnyard Grass	4.6	17.	4.	3.	8.5	13.6	57.
Lactuca canadensis .... Wild Lettuce	------	2.6	50.	7.	2.	2.	37.3
Melilotus alba ..... White Sweet Clover	2.5	4.	2.6	6.6	2.5	6.	11.3
Rumex crispus ..... Curled Dock	15.3	18.5	1.5	12.	15.4	12.	36.
Polygonum Pennsylvanicum ..... Pennsylvania Smartweed	3.	5.5	8.5	------	1.	------	45.
Verbena urticaefolia .... Wild Vervain	5.5	5.	1.	.66	4.5	5.3	31.5

It would seem that freezing is decidedly favorable for the germination of many weed seeds. Of 65 species planted November, 1908, 4 species failed to germinate; of 60 species planted in December, 48 failed; of 63 species planted in January, 44 failed; of the March planting of 62 species, 27 failed; of 59 species planted in April, 46 failed, of the seeds exposed to the weather, 64 species, 24 failed to germinate.

The uncertainty of germination is closely indicated in some experiments not yet completed, made by Mr. H. S. Coe, with jimson weed (*Datura Stramonium*), velvet weed (*Abutilon Theophrasti*), green foxtail (*Setaria viridis*), ragweed (*Ambrosia*

trifida), Iowa thistle (*Cirsium Iowense*), and a number of other weed seeds. In the experiment the seeds of each of these were heated for five days at 35° C.; another sample heated two hours at 70° C.; then planted on October 22. The following interesting data was obtained with reference to the germination of these seeds. None of the seeds of the ragweed germinated, and only two seeds that were heated of the Iowa thistle germinated while none of the check germinated. This work certinly points strongly to the fact that many seeds have a long period of rest, perhaps longer in seeds with a thick coat than in the thinner coated seeds.

TABLE 10. EFFECT OF HEATING ON WEED SEED GERMINATION.

	Planted October 22nd. 1909					
	5 da. 35° C		2 hrs 70° C		Check	
	18 da.	165 da.	18 da.	165 da.	18 da.	165 da
Datura Stramonium ..... Jimson weed	0	25	2	97	0	81
Abutilon Theophrasti ..... Velvet weed	1	20	15	15	5	20
Setaria viridis ..... Green foxtail	2	71	1	1	2	3

With the closest care and observation there was lack of constancy in the germination of the various weed seeds studied by us, resulting in marked irregularities not to be attributed to known causes.

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